OFFICE OF MANNED SPACE FLIGHT

APOLLO APPLICATIONS PROGRAM

PROGRAM DIRECTIVE NO. 3B

FLIGHT MISSION DIRECTIVE FOR AAP-1/AAP-2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON 25, D. C.

OFFICE OF MANNED SPACE FLIGHT PROGRAM DIRECTIVE	M-D ML 3200.055 (Project)	DATE 6/19/67

APOLLO APPLICATIONS
PROGRAM DIRECTIVE NO. 3B

TO : Distribution

FROM: Charles W. Mathews
DIRECTOR, SAA PROGRAM

SUBJECT: Flight Mission Directive for Mission AAP-1/AAP-2

REF : (a) Apollo Applications Flight Mission Assignments Directive (to be revised)
(b) Apollo Applications Planning Schedule ML-5B (to be revised)
(c) Apollo Flight Mission Assignments Directive (to be revised)
(d) Apollo Test Requirements, NHB 8080.1, dated March 1967
(e) Apollo Program Directive No. 6A dated 8/30/66
(f) Apollo Program Directive No. 15 dated 1/25/66
(g) Reliability and Quality Assurance Plan, NHB 5300.5, dated May 1967

PURPOSE: This Directive defines AAP requirements and responsibilities to initiate those actions prerequisite to execution of the AAP-1/AAP-2 Mission authorized in reference (a). The mission is scheduled for launch as indicated in reference (b) in the event that the launch vehicles and spacecraft assigned to the Apollo-Saturn missions, reference (c), are not required to support the mainline Apollo Program. This Directive supersedes SAA Program Directive No. 3A dated 12/30/66.

1.0 MISSION PURPOSE

The purposes of the AAP-1/AAP-2 Mission are as follows:

1.1 Conduct a low altitude, low inclination earth orbital mission with a crew of three men, open ended to 28 days duration using a spent S-IVB stage as an Orbital Workshop.

1.2 Provide for reactivation and reuse of the Orbital Workshop during subsequent missions occurring up to one year later.

1.3 Conduct in-flight experiments in the areas of science, applications, technology, engineering and medicine.

1.4 Qualify man, evaluate his support requirements and determine human task performance capability on long duration manned space flight missions.

2.0 MISSION OBJECTIVES

2.1 Primary Objectives: The primary objectives of Mission AAP-1/AAP-2 are listed below. They may be amplified but not modified by the centers. Preflight malfunctions of spacecraft or launch vehicle systems, ground equipment or instrumentation which would result in failure to meet these objectives will be cause to hold or cancel the mission until the malfunction has been eliminated.

a. Demonstrate rendezvous and hard docking of the CSM to the Multiple Docking Adapter.

b. Determine the feasibility of operating the Orbital Workshop as a habitable space structure for a period of up to 28 days from the AAP-1 launch date through evaluation of CSM/S-IVB/Airlock/Multiple Docking Adapter to include the following:

(1) Subsystems performance.
(2) Astronaut mobility and work capability in both intra- and extra-vehicular activity.

c. Obtain data to evaluate space flight environmental effects on the crew of a mission duration up to 28 days (Experiments M050, M051, M052).

2.2 Secondary Objectives: The secondary objectives of Mission AAP-1/AAP-2 are summarized below. Preflight malfunctions of spacecraft or launch vehicle systems, ground equipment or instrumentation which would result in failure to meet these objectives may be cause to hold or cancel the mission as specified in the Mission Rules.

a. Demonstrate passivation of the spent S-IVB stage and activation of the Workshop as a habitable space structure (elements of M402 Experiment).

b. Demonstrate the feasibility of extending CSM mission duration through incorporation of additional expendables in the Service Module.

c. Leave the Orbital Workshop in orbit for reactivation and reuse up to one year later.

d. Verify the ability of mission ground support systems to support mission activities of extended duration.

e. Obtain engineering and technological data needed for development of advanced space vehicles and equipment (Experiments T002*, D017*, M466, M469, M479, M486, M487, M488, M489, M492, M493, D018, D019, D020, D021, D022, T017, T020, T021, T022, T023).

f. Obtain data prerequisite to identification of earth resources and development of improved cartographic procedures (Experiment S065*).

g. Obtain data to develop a more complete understanding of the physical characteristics of the extra-atmospheric environment (Experiments S009*, S018*, S063*).

h. Obtain medical and biological data as required for evaluation of the effects of weightlessness on man (Experiments M018, M053, M055, T004*).

i. Obtain stellar and solar astronomy data (Experiments S069, S019*, S070*).

3.0 GENERAL FLIGHT PLAN

3.1 Launch Vehicle Powered Flights:

a. AAP-1 is a manned flight involving an Uprated Saturn I launch vehicle and a modified Apollo Block II CSM. It will be launched from LC 34 at KSC at a time and azimuth to facilitate rendezvous with the AAP-2 Orbital Workshop.

b. AAP-2 is an unmanned flight involving an Uprated Saturn I launch vehicle, an Airlock, a Multiple Docking Adapter and a nose cone. It will be launched from LC 37B at KSC into a 260 n. mi. circular orbit at a time and azimuth to facilitate rendezvous with the AAP-1 spacecraft.

3.2 Spacecraft Flight Profile: The launch timing and orbital inclination of the AAP-1 spacecraft will be selected to permit expeditious rendezvous with the AAP-2 Orbital Workshop. After injection into orbit

* Under consideration for deletion from this mission and reassignment to AAP-1A.

the CSM will separate from the SLA and the CSM SPS will be used to make the requisite transitional maneuvers to rendezvous with the Orbital Workshop. The CSM will dock to the radial port of the Multiple Docking Adapter and the Orbital Workshop will be activated for habitation. The remainder of the 28-day mission will be devoted to the conduct of experiments and evaluation of the Orbital Workshop systems. The CSM will then return to earth leaving the Orbital Workshop inactive in earth orbit.

3.3 Interface with Future AAP Missions: Since the plan for execution of primary mission objectives of subsequent missions will be constrained by the operational capability of the hardware placed in orbit by AAP-1/AAP-2, it is imperative that the following requirements be considered concomitantly with the AAP-2 S-IVB stage modifications and the Airlock/Multiple Docking Adapter design:

a. Revisitation and reactivation of the EPS and ECS for a period of up to 56 days by AAP-3/AAP-4.

b. Possible revisitation and reactivation of the EPS and ECS during the period between AAP-1/AAP-2 and AAP-3/AAP-4.

c. Incorporation of systems status monitoring equipment for ground interrogation during inactive orbital storage.

d. Radial docking of a Lunar Module (ascent stage)/Apollo Telescope Mount (LM/ATM).

e. Accommodation of ancillary hardware for conduct of additional experiments carried on later missions.

3.4 Recovery: Water recovery to be developed for the CM consistent with the above stated profile characteristics and the normal recovery constraints associated with the deployment of recovery forces and the local lighting conditions at the time of recovery.

3.5 Mission Support Requirements: These requirements will be supplied in a "Program Support Requirements" document to be issued by the Operations Support Office, Mission Operations, OMSF, not later than four months prior to launch.

4.0 CONFIGURATION

4.1 Launch Vehicles: Uprated Saturn I launch vehicles as assigned by references (a) and (b) will be used for the AAP-1 and AAP-2 flights. With the exception of the AAP-2 S-IVB, modifications will be limited to the minimum necessary to achieve proper trajectory stabilization and control. The AAP-2 S-IVB will be modified to incorporate the following:

a. Orbital Workshop facilities:

(1) Propulsion system passivation.
(2) LH_2 tank conversion for habitation.
(3) Micrometeoroid bumper.
(4) Fire retardant liner.
(5) Ancillary hardware to support experiments designated for execution in the Orbital Workshop.

b. Solar cell power system to supply electric power to the Airlock power distribution system after injection into orbit.

c. An auxiliary attitude control system for S-IVB attitude control after injection into orbit.

4.2 Nose Cone: A nose cone as designed for an unmanned Apollo LM launch which will provide an aerodynamic shroud during the powered portion of flight AAP-2 will be utilized. It will be separated from the orbital payload after injection into orbit.

4.3 Airlock/Multiple Docking Adapter: The Airlock/Multiple Docking Adapter will:

a. Provide access to the S-IVB after it is in orbit.

b. Provide a two-gas life support pressurization and environmental control system for itself and the S-IVB Workshop.

c. Provide a power distribution system to receive power supplied by the CSM fuel cells and the S-IVB solar arrays and to distribute power as required by the S-IVB, MDA, Airlock and experiments.

d. Provide for emergency power distribution to the LM/ATM (AAP-3/AAP-4) when it is hard docked to the MDA.

e. Provide for experiment support for both the AAP-1 and AAP-2 flights as well as that required for execution of AAP-3/AAP-4.

f. Carry instrumentation for operational evaluation of the Airlock/S-IVB Workshop as a habitable space structure.

g. Provide for storage in the MDA of all experiments designated for transport therein during powered flight. MDA will be configured to provide backup work space for execution of experiments in the event the Orbital Workshop is inaccessible.

h. Provide four radial docking ports and an in-line port. The radial ports will permit docking to the Airlock of a LM/ATM and a CSM. The in-line port will provide for docking of a CSM.

i. Provide sufficient in-orbit monitoring and command capability for the storage period to determine equipment status.

4.4 Spacecraft: The AAP-1 CSM will be a standard Block II Apollo configuration modified to:

a. Provide electrical power to the Airlock.

b. Carry and support experiment hardware as required.

c. Provide a low pressure GOX internal umbilical to the Airlock EVA system.

d. Incorporate a backup retrofire capability.

e. Provide expanded SM-RCS propellant capabilities to support the AAP-1/AAP-2 Mission.

f. Carry O_2, N_2 and H_2 consumables to extend the AAP-1/AAP-2 Mission to 28 days.

4.5 SLA: The SLA for AAP-2 will be modified as necessary to accommodate launch of the Airlock/MDA and to insure that the SLA panels do not interfere with orbital operation of the S-IVB/Airlock/MDA.

5.0 EXPERIMENTS

The experiments which have been approved for execution on AAP-1/AAP-2 (reference (a)) are identified below as they pertain to accomplishment of the primary and secondary objectives, respectively.

5.1 Primary Objective Experiments:

Flight No.	Exp. No.	Title	Dev. Center
		Engineering	
AAP-2	M402	Orbital Workshop	MSFC
		Medical	
AAP-2	M050	Metabolic Activities	MSC
AAP-2	M051	Cardiovascular Function Assessment	MSC
AAP-1	M052	Bone and Muscle Changes	MSC

5.2 Secondary Objective Experiments:

Flight No.	Exp. No.	Title	Dev. Center
		Engineering	
AAP-2	M469	ST-124 Removal and Disassembly	MSFC
AAP-2	M479	Zero Gravity Flammability	MSC
AAP-2	M486	Astronaut EVA Equipment	MSC
**AAP-2	M487	Habitability of Crew Quarters	MSFC
AAP-2	M488	High Pressure Gas Expulsion	MSC
AAP-2	M489	Heat Exchanger Service	MSC
AAP-2	M492	Tube Joining in Space	MSFC
AAP-2	M493	Electron Beam Welding	MSFC
		Medical	
AAP-2	M053	Human Vestibular Function	MSC
AAP-2	M055	Time and Motion Studies	MSC
		Technology	
AAP-1	T002*	Manual Navigation Sightings	ARC/MSC
AAP-2	T017	Meteoroid Impact and Erosion	MSC
AAP-2	T020	Jet Shoes	LaRC
AAP-2	T021	Meteoroid Velocity	MSC

* Under consideration for deletion from this mission and reassignment to AAP-1A.

** Elements of this experiment should be recognized as contributing to the accomplishment of primary objective 2.1.b.

Flight No.	Exp. No.	Title	Dev. Center
		Science and Applications	
AAP-2	S009*	Nuclear Emulsion	MSC
AAP-1	S065*	Multiband Terrain Photography (Hand Held)	MSC
		Department of Defense	
AAP-1	D017*	Carbon Dioxide Reduction	AF/MSC
AAP-2	D018	Integrated Maintenance	AF/MSC
AAP-2	D019	Suit Donning and Sleep Station Evaluation	AF/MSC
AAP-2	D020	Alternate Restraints Evaluation	AF/MSC
AAP-2	D021	Expandable Airlock Technology	AF/MSC
AAP-2	D022	Expandable Structure for Recovery	AF/MSC

5.3 The experiments listed below have been assigned by AA/MSF to AAP for implementation on AAP missions. They are categorized as secondary mission objective experiments for the AAP-1 and AAP-2 flights. Firm assignment by flight will be made on conclusion of compatibility studies now in progress.

Exp. No.	Title	Dev. Center
	Engineering	
M466	Space Suit Evaluation	MSC
	Medical	
M018	Vectorcardiogram	MSC
	Technology	
T004*	Frog Otolith Function	ARC/MSC
T022	Heat Pipe	MSFC
T023	Surface Adsorbed Materials	MSFC

* Under consideration for deletion from this mission and reassignment to AAP-1A.

Exp. No.	Title	Dev. Center
	Scientific	
S069	X-ray Astronomy	MSC
S018*	Micrometeoroid Collection	MSC
S019*	UV Stellar Astronomy	MSC
S070*	UV/X-ray Solar Photography	MSC
S063*	UV Airglow Horizon Photography	MSC

6.0 SUPPORTING GROUND TEST CONSTRAINTS

Test program will be conducted in accordance with NHB 8080.1 (reference (d)) as modified by the Apollo Applications Test Requirements document (to be issued) and appropriate test specifications. Mission Requirements documents prepared by the centers in support of these missions will identify by inclusion or reference the test constraints which must be lifted prior to mission execution.

6.1 Qualification: Components of the spacecraft, launch vehicles, nose cone, S-IVB/Airlock/Docking Adapter System, flight experiment hardware and associated support systems whose failure would jeopardize either crew safety (Category I) or the accomplishment of a primary mission objective (Category II) and which have not been flight tested will be ground qualified and/or certified prior to launch. Basic Apollo hardware which has been flight tested (i.e., CSM) will be subjected to additional ground qualification and/or certification tests as required to provide confidence in meeting the long duration and other pertinent AAP requirements.

6.2 Launch Vehicles: The following flight stage and acceptance tests will be performed on the AAP-1 and AAP-2 launch vehicles:

a. Manufacturing checkout of the IU's and S-IB and S-IVB flight stages.

b. Static test of the S-IB and S-IVB flight stages.

c. Post static checkout of the S-IB and S-IVB flight stages.

d. KSC inspection tests of the IU's and S-IB and S-IVB flight stages.

* Under consideration for deletion from this mission and reassignment to AAP-1A.

6.3 Nose Cone: The following ground tests will be performed:

a. Structural verification analysis.

b. Factory acceptance inspection.

c. KSC inspection.

6.4 Airlock with Multiple Docking Adapter: The Airlock with Multiple Docking Adapter shall be fully qualified to support manned operations. In support of this requirement the following ground tests will be performed:

a. Airlock

(1) Development tests.
(2) Qualification and/or certification tests as required to meet AAP mission requirements.
(3) Systems tests.
(4) Manufacturing checkout and acceptance tests.
(5) KSC prelaunch tests.

b. MDA

(1) Development tests.
(2) Qualification and/or certification tests as required to meet AAP mission requirements.
(3) Experiment payload integration tests.
(4) Manufacturing checkout and acceptance tests.
(5) KSC prelaunch tests.

c. Airlock/MDA systems compatibility tests.

6.5 AAP-2 S-IVB: The AAP-2 S-IVB shall be fully qualified to support manned operations in earth orbit. In support of this requirement, the following ground tests will be performed:

a. Orbital Workshop Modifications: The stage as modified for powered flight with selected hardware for conversion to an Orbital Workshop pre-installed will require:

(1) Development tests.
(2) Manufacturing and acceptance tests.
(3) Qualification and/or certification tests as required to meet AAP mission requirements.
(4) Static tests.
(5) Post static test checkout.
(6) KSC inspection tests.

b. Solar Array Modifications: The solar array system will require:

(1) Development tests.
(2) Qualification tests.
(3) Airlock/S-IVB systems integration tests.
(4) Manufacturing checkout and acceptance tests.
(5) KSC prelaunch tests.

c. Auxiliary Attitude Control System: The auxiliary control system will require:

(1) Development tests.
(2) Qualification tests.
(3) Integrated systems tests.
(4) Manufacturing and acceptance tests.
(5) KSC prelaunch tests.

6.6 AAP Experiments: The following ground tests will be performed:

a. Qualification tests for each experiment.

b. Factory checkout and acceptance test of experiment and associated support systems.

c. Payload integration tests of experiment and associated support systems with carriers.

d. KSC prelaunch tests.

6.7 Spacecraft: The following major flight article ground tests will be performed on the AAP-1 CSM:

a. Factory checkout and acceptance tests.

b. Qualification tests for all AAP peculiar subsystems modifications to verify operation for the AAP-1/AAP-2 Mission.

c. KSC prelaunch tests.

6.8 SLA: The following ground tests will be performed on the AAP-2 SLA as modified to meet mission requirements:

a. Development tests.

b. Structural verification tests.

c. Manufacturing checkout and acceptance tests.

d. KSC preflight checkout tests.

6.9 Prior Flight Missions: All launch vehicle, spacecraft and nose cone test anomalies resulting from all previous missions which could degrade or interfere with primary objectives will be fully evaluated and corrected prior to the launch of AAP-1 or AAP-2.

6.10 Design Certification Review (DCR): An AAP DCR will be conducted to certify all new hardware and all changes from the standard Apollo hardware required for this mission. Basic Apollo hardware already certified in previous DCR's will be recertified as required to meet AAP extended life and/or performance requirements. This review will also include certification of experiments likely to affect flight worthiness, manned flight safety and/or primary mission objectives. The DCR shall be in accordance with Apollo Program Directive No. 6A (reference (e)) as to be modified for AAP.

6.11 Certification: A Certification of Flight Worthiness (reference (d)) for each stage, SLA, IU, spacecraft, Airlock/Docking Adapter and module (including the S-IVB LH_2 tank as an inhabited structure) is required prior to shipment from the factory and after static firing if appropriate. In addition, experiments whose failure would jeopardize crew safety (Category I) or the accomplishment of a primary mission objective (Category II) will also require preparation of a COFW. Final updated and signed COFW's by the program managers will be required at the Flight Readiness Review and close out of open items prior to launch will be in accordance with Apollo Program Directive No. 15 (reference (f)) as to be modified for AAP.

7.0 RELIABILITY AND QUALITY ASSURANCE

A Reliability and Quality Assurance Program will be conducted in accordance with the Reliability and Quality Assurance Plan (reference (g)) issued by SAA, R&QA, OMSF.

8.0 RESPONSIBILITIES

Center responsibilities for implementation of this mission are as follows:

8.1 MSFC:

a. Provide the Saturn IB launch vehicles and required vehicle and GSE modifications.

b. Develop the Orbital Workshop (Experiment M402) to include AAP-2 S-IVB solar array installation, stage modifications and kit preparation as required.

c. Develop assigned experiments and supporting hardware.

d. Integrate assigned experiments into the AAP-1 launch vehicle.

e. Integrate all experiments designated for transport in the AAP-2 flight

f. Develop and integrate the nose cone with the AAP-2 payload.

g. Conduct guidance and control dynamics analyses for the ground launched space vehicle configuration and develop the requisite launch vehicle guidance and control capability.

h. Analyze the cluster maneuver dynamics for the AAP-1/AAP-2 Mission.

i. Conduct analyses in coordination with MSC in the areas of instrumentation and communications, electrical power distribution and expendables distribution for the space module cluster configuration as required for development of the Orbital Workshop (S-IVB spent stage) and the MDA.

j. Develop the MDA and associated GSE.

k. Provide launch vehicle performance constraints, systems data and guidance support to MSC for mission planning.

l. Provide technical support to MSC in support of their development of crew training procedures and flight operations planning for the Orbital Workshop, MDA and MSFC assigned/designated experiments.

m. Provide technical support to KSC as required during the acceptance, modification, prelaunch checkout and launch phases of this mission.

n. Provide operational support to MSC as required during AAP-1/AAP-2 flight operations.

8.2 MSC:

a. Provide the CSM and associated GSE for the AAP-1 Mission.

b. Develop modification kits as required for the CSM to accomplish mission objectives.

c. Integrate experiments designated for transport in the AAP-1 CSM.

d. Develop the Airlock, associated GSE, and modification kits for the SLA to accomplish mission objectives.

e. Develop assigned experiments, supporting hardware and associated GSE.

f. Conduct thermal balance analyses for the orbital assemblage.

g. Conduct analyses in coordination with MSFC in the areas of instrumentation and communications, electrical power distribution and expendables distribution for the space module cluster configuration as required for development of the Airlock and CSM.

h. Plan the mission to include mission design and develop the astronaut flight plan with appropriate inputs from MSFC for the Workshop, MDA and MSFC assigned experiments.

i. Plan and execute flight control, experiment and recovery operations.

j. Train the astronaut crew.

k. Provide technical support to KSC as required during the acceptance, modification, checkout, prelaunch and launch phases of this mission.

8.3 KSC:

a. Prepare the GSE and conduct prelaunch checkout of the launch vehicles.

b. Prepare the GSE and conduct prelaunch checkout of the spacecraft and experiment hardware for AAP-1.

c. Install MSC and MSFC supplied kits and conduct modifications to Apollo hardware as required for execution at the launch site.

d. Prepare the GSE and conduct prelaunch checkout of the Airlock, MDA and experiment hardware for AAP-2.

e. Plan and execute space vehicle launch operations.

f. Provide technical support as required to MSC and MSFC concerning the KSC implementation of modifications to flight hardware and GSE hardware.

9.0 IMPLEMENTATION

MSC, MSFC and KSC shall develop Mission Requirements documents to implement the requirements stated herein. The MSC/MSFC requirements will be combined in a jointly signed-off directive.

Subsequent changes and future revisions to center Mission Requirements documents noted above which conflict with the requirements stated herein will require coordination between the centers and the review and approval of the Saturn Apollo Applications Program Director. Other revisions to the center Mission Requirements documents will be coordinated between centers as required with ten copies submitted to the Director, Saturn Apollo Applications Program, Code ML, for information.

DISTRIBUTION:

OMSF
M/Mueller
M-1/Bowman
MDM/Bogart
MD-T/Shea
MA/Phillips
MA-1/Schaibley
MA-2/Keegan
MA-3/McGregor
MA-4/Turnock
MA-5/Russell
MA-6/Reiffel
MAO/Holcomb (5)
MAP/Seccomb (10)
MAR/White (7)
MAS/Wagner (8)
MAS/Penn
MAT/Day (5)
MB/Armstrong
MC/Freitag
MCL/Ashley
MF/Evans
MF/Coulter (2)
MM/Bollerud (2)
MM/McLaughlin
M-N/Alibrando
MO/Stevenson (5)
MOR/Brown (10)
MP/White (2)
MPP/Rafel (2)
MPR/Johnson
MS/Cotton
MSR/Davis
MT/Trimble (9)
MTD/Lord
MTE/Raffensperger
MTL/Beattie
MTL/Director
MTS/Hall
MTX/George
MTX/Hall
MTY/Dixon
ML/Mathews
MLD/Disher
ML-1/Levenson
MLV/Fero
MLA/Culbertson (8)
MLO/Edwards (5)
MLP/Field (12)
MLP-4/Koutsandreas (5)
MLP-5/Poore (4)
MLR/Cohen (4)
MLS/Hagner (7)
MLT/Savage (14)

OSSA
S/Newell
SD/Cortright
SE/Hage
SV/Johnson
SM/Foster (5)
SL/Nicks
SS/Naugle
SG/Mitchell
SG/Forsythe
SA/Jaffe
SB/Reynolds

OART
R/Adams
R/Eggers
RD/Myers
RA/Harper
RB/Jones
RP/Tischler
RV/Ames
RE/Sullivan
RN/Woodward
RND/Deputy Director
RNV/Novik (5)

OTDA
T/Buckley
TD/Truszynski
TA/Morrison
TS/Pozinsky
TR/Bryant

OPPA
PT/Maggin

GSFC
500/Covington
512/Roberts
513/Vonbun

KSC
AA/Debus
AB/Seipert
GA/VanStaden
XA/Hock
XC/Raffaelli (60)
HA/Petrone
DA/Mathews
CA/Murphy
MA/Bagnulo
MA/Clark
RA/Parker

MSC
AA/Gilruth
AB/Deputy Director
AD/West
KA/Thompson (40)
PA/Low
EA/Faget
TA/Piland
ET/Stoney
FA/Kraft (2)
GA/Slayton
AH/Berry
FA4/Fielder

MSFC
DIR/von Braun
DEP-T/Rees
EX/Maus
I-DIR/O'Connor
I-DIR/Mrazek
I-MO/Speer
I-S/AA-MGR/Belew (5)
I-S/AA/Ferguson
I-S/AA/Ise
I-S/AA/Reinartz
I-S/AA/Clingman
I-S/AA-T/Chambers
I-I/IB-MGR/Teir
I-V-MGR/Rudolph
R-RP/Stuhlinger
R-AS/Williams
R-AERO-D/Horn
I-RM-M/Goldston (60)
(Data Manager)

MSC
BM6/Tash (5)
CB/Astronauts' Office (4)
CF/North (2)
CF32/Jones (2)
FC/Hodge (8)
FM/Mayer (2)
FM14/Parten (3)
FL/Hammack
FS/Clements
TP/Dell
TA/Jackson